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SPECIES OF THE GENUS *PLANOCOCCUS* FERRIS, 1950 (HEMIPTERA: COCCOIDEA: PSEUDOCOCCIDAE) WITH SPECIAL REGARD TO *PLANOCOCCUS VOVAE* (NASONOV, 1908) AS A SPECIES NEWLY RECORDED IN CROATIA

TATJANA MASTEN MILEK[1], MLADEN ŠIMALA[1] & STJEPAN KRČMAR[2]

[1]Institute for Plant Protection in Agriculture and Forestry of the Republic of Croatia, Svetošimunska cesta 25, HR-10000 Zagreb, Croatia (tatjana.masten@zzb.hr)

[2]J. J. Strossmayer University in Osijek, Department of biology, Trg Ljudevita Gaja 6, HR-31000 Osijek, Croatia

Masten Milek, T., Šimala, M. & Krčmar, S.: Species of the genus *Planococcus* Ferris, 1950 (Hemiptera: Coccoidea: Pseudococcidae), with special regard to *Planococcus vovae* (Nasonov, 1908) as a species newly recorded in Croatia. Nat. Croat., Vol. 17, No. 3, 157–168, 2008, Zagreb.

This paper deals with the scale insects *Planococcus citri* (Risso, 1813), *Planococcus ficus* (Signoret, 1875) and *Planococcus vovae* (Nasonov 1908) monitored during a four year faunistic investigation (2005–2008) of the genus *Planococcus* Ferris, 1950 in Croatia. *P. vovae* is a new species for Croatia. Distribution (according to UTM system) and host plants of these species in Croatia are reported. Some morphological characters useful for the differentiation of these three species are also described.

Key words: *Planococcus citri*, *Planococcus ficus*, *Planococcus vovae*, distribution, morphology, Croatia

Masten Milek, T., Šimala, M. & Krčmar, S.: Vrste roda *Planococcus* Ferris, 1950 (Hemiptera: Coccoidea: Pseudococcidae) s naglaskom na *Planococcus vovae* (Nasonov, 1908) kao novoregistriranoj vrsti u Hrvatskoj. Nat. Croat., Vol. 17, No. 3, 157–168, 2008, Zagreb.

Rad govori o štitastim ušima *Planococcus citri* (Risso, 1813), *Planococcus ficus* (Signoret, 1875) i *Planococcus vovae* (Nasonov, 1908) koje su utvrđene monitoringom roda *Planococcus* Ferris, 1950 tijekom četverogodišnjih faunističkih istraživanja (2005.–2008.) u Hrvatskoj. *P. vovae* je novoregistrirana vrsta za Hrvatsku. Rasprostranjenost utvrđenih vrsta i njihovih domaćina u Hrvatskoj prikazana je prema UTM sustavu. Opisana su i neka morfološka obilježja potrebna za razlikovanje utvrđenih vrsta.

Ključne riječi: *Planococcus citri*, *Planococcus ficus*, *Planococcus vovae*, rasprostranjenost, morfologija, Hrvatska

INTRODUCTION

Scale insects are some of the most unusual insects known. The adult females are sexually mature wingless nymphs. By contrast, the males are mostly winged insects that usually live only for a day or even less and never feed. Male scales, though part of the Hemiptera, which have incomplete metamorphosis, have their own specially derived form of a complete metamorphosis with two pupal instars. Adult females are sack-like with no clear segmentation in head, thorax and abdomen, and they may or may not have legs. The ephemeral males have two pairs of wings, but the hind wings are very small and attached with one or more setae to the forewings (BEN-DOV *et al.*, 2008).

Species of the genus *Planococcus* Ferris, 1950 (Fam. Pseudococcidae) are characterized by 18 pairs of cerarii (although some thoracic pairs may be indistinct). All abdominal cerarii have only 2 conical setae and no auxiliary setae. They are anterior to the anal lobe pair which also has only 2 conical. Circulus is usually present. Translucent pores are usually present on the hind coxae (COX, 1989). The ventral side of the anal lobes always has a slender anal lobe bar (sclerotized area extending in the form of the base of anal lobe setae) (MCKENZIE, 1967).

According to BEN-DOV (2008), in the Palaearctic region the genus *Planococcus* comprises 11 species. Five species have been recorded in Europe, namely *Planococcus citri* (Risso, 1813), *Planococcus ficus* (Signoret, 1875), *Planococcus halli* Ezzat & McConnell, 1956, *Planococcus taigae* Danzig, 1986 and *Planococcus vovae* (Nasonov, 1908). *P. citri*, *P. ficus* and *P. vovae* are European indigenous species, largely distributed all over Europe. *P. taigae* is a Euro-Asiatic species restricted to Russia. On the other hand, *P. halli* is an introduced alien species which has to date been recorded only in Italy (MAROTTA, 1992). *P. citri* and *P. ficus* are species distributed worldwide, while *P. vovae* is restricted to the Palaearctic region.

This paper deals with the species and distributional data of the scale genus *Planococcus* occurring in Croatia. Emphasis is placed on *P. vovae* as a newly recorded species for the fauna of Croatia.

MATERIAL AND METHODS

Faunistic investigations on scale insects were carried out over a 4 year period (2005–2008) in 21 counties of Croatia by visual inspection of potentially infested plants.

The survey was carried out as follows:

- Visual inspection of potentially infested plant material with the help of a magnifying lens of 10x magnification.
- Collecting of host plant material infested with scale insects (leaves and stems) in plastic bags, labelling each sample with collection data (country, locality details, host plant, any damage symptoms, collector's name, samples number, date).

Fig. 1. Adult female of *Planococcus citri* (Risso, 1913) (photo: T. Masten Milek)

- Observation of field characters of collected specimens under an Olympus SZ 51 dissecting stereo microscope. Taking photos of scales with the Olympus 510 UZ digital camera.
- Slide mounting according to the methods of WATSON & CHANDLER (1999).
- Microscopic identification on the basis of morphological characters of adult females according to keys by BORCHSENIUS (1949), TEREZNIKOVA (1975), COX & BEN-DOV (1986), KOSZTARAB & KOZAR (1988), COX (1989) and MAROTTA (1990).
- Microscopic slide labelling with all data relevant for faunistic entry.
- Marking the localities of finding according to the UTM system (HORVAT *et al*., 2003).
- Identification of *P. citri, P. ficus* and *P. vovae* was confirmed by Professor Giuseppina Pellizzari, DSc, from Dipartimento di Agronomia Ambientale e Produzioni vegetali, Università di Padova, Italy and Gabrijel Seljak, MSc, from the Agriculture and Forestry Institute in Nova Gorica, Slovenia.

RESULTS AND DISCUSSION

With regard to the genus *Planococcus* in Croatia, this survey has confirmed the presence of *P. citri, P. ficus* and *P. vovae. P. vovae* has not been yet recorded in Croatia. Information on these species is reported below.

Planococcus citri (Risso, 1813)

P. citri is a very common Palaearctic scale insect. It is one of the most cosmopolitan mealybugs, damaging many outdoor crops in the tropics and subtropics, as well as in greenhouses in the temperate regions. It is extremely polyphagous, associated with host plants from at least 70 families (BEN-DOV, 2008).

The female body is oval, yellow in teneral specimens, pink or orange-brown when fully mature. Its body is covered with white mealy wax, which is not thick enough completely to hide the body colour, with a dorsomedial bare area forming a central longitudinal stripe on the dorsum (more obvious than in *P. ficus*) (see Fig. 1.).

The first record of *P. citri* in Croatia dates from 1926 (NOVAK, 1928). This was a record of *Citrus limon* L. From the locality of the islands of Lopud and Šipan (near Dubrovnik). After that, according to the later literature data, this species was recorded on many hosts in greenhouses and indoors (SCHMIDT, 1956). It was reported as being widespread on *Citrus* spp. and *Vitis vinifera* L. all over the Croatian coast (Card-file of Institute of Plant Protection, 1979–1987). During our investigation, *P. citri* was only found in greenhouses and indoors in 15 localities and on 19 different host plants (see Tab. 1.). Contrary to the previous records in the Croatian literature, in our investigation *P. citri* has not been found on *V. vinifera.*

Planococcus ficus (Signoret, 1875)

P. ficus is a common polyphagous Palaearctic mealybug, distributed worldwide and known as a pest of *Vitis vinifera* in the Mediterranean region, South Africa, Pakistan and Argentina (BEN-DOV, 1994). This species was frequently misidentified as *P. citri* before the works of EZZAT & MCCONNELL (1956) and DE LOTTO (1975) and most records of *P. citri* from grapevines should be referred to *P. ficus* (COX, 1989). TRANFAGLIA (1978) and TREMBLAY *et al.* (1983) pointed out and evaluated the great morphological affinity of *P. ficus* and *P. citri.*

The female body is oval, yellow in teneral specimens, pink or orange-brown when fully mature. The body is covered with white mealy wax, which is not thick enough completely to hide the body colour, with a dorsomedial bare area forming a central longitudinal stripe on the dorsum (less obvious than in *P. citri*) (see Fig. 2.).

The first record of *P. ficus* in Croatia dates from 1925. It was found on *Ficus carica* L. in Kaštel Sućurac (near Split) (NOVAK, 1928). There are few data about this species in the Croatian literature. In the past, findings of these species were strictly connected to *F. carica*.

On *V. Vinifera*, *P. ficus* was recorded for the first time in 2006 in Repušnica (MASTEN MILEK, 2007). During our investigation this mealybug was found in 10 localities, always only on *F. carica* or *V. vinifera*. Nevertheless, *V. vinifera* was the preferred host plant in our findings (see Tab. 2.). No damage to the vine caused by this mealybug has been recorded in Croatia. Otherwise, it is well known as a vector of some harmful virus diseases of the grapevine (e.g. grapevine leaf roll virus).

Tab. 1. Host plants, localities and date of finding of *Planococcus citri* (Risso, 1813) examined during a four-year faunistic investigation in Croatia (2005-2008)

SPECIES	PLANT FAMILY	HOST PLANT	LOCALITY	UTM	DATE
Planococcus citri (Risso, 1813)	Araceae	*Alocasia* (Schott) G. Don f. sp.	Split Dujlovo MBM*	33T XJ2118	29.9.2006.
		Alocasia (Schott) G. Don f. sp.	Knežine MBM*	33T XJ0722	15.12.2006.
	Asclepiadaceae	*Stephanotis floribunda* (R.Br.) Brongn.	Turanj MBM*	33T WJ3368	9.6.2006.
		Stephanotis floribunda (R.Br.) Brongn.	Dubrovnik MBM* SZJK	34T BN6126	7.9.2006.
	Balsaminaceae	*Impatiens glandulifera* Royle	Dubrovnik MBM* SZJK	34T BN6126	1.8.2006.
	Dracenaceae	*Beaucarnea* L. sp.	Zagreb Žitnjak*	33T WL8370	22.9.2006.
	Ericaceae	*Rhododendron* L. sp.	Zagreb Žitnjak*	33T WL8370	22.9.2006.
	Euphorbiaceae	*Codiaeum variegatum* (l.) Blume	Zagreb Zrinjevac*	33T WL7469	24.5.2006.
		Codiaeum variegatum pictum (Lodd.) Muell. Arg.	Turanj MBM*	33T WJ3368	9.6.2006.
	Geraniaceae	*Pelargonium* L. Herit sp.	Tisno*	33T WJ5150	10.6.2006.
		Pelargonium L. Herit sp.	Hum na Sutli*	33T WM5318	25.9.2006.
	Moraceae	*Ficus* L. sp.	Zagreb Zrinjevac*	33T WL7469	24.5.2006.
		Ficus L. sp.	Dubrovnik*	34T BN6126	24.7.2006.
		Ficus macrophylla Desf. Ex Pers.	Knežine MBM*	33T XJ0722	1.6.2006.
		Ficus L. sp.	Knežine MBM*	33T XJ0722	1.6.2006.
		Ficus microcarpa L.f.	Varaždin*	33T XM0329	3.8.2006.
		Ficus rubiginosa Desf. Ex Vent.	Ilok*	34T CR7308	7.9.2006.
	Myrtaceae	*Metrosideros* Banks ex Gaertner sp.	Split Dujlovo MBM*	33T XV2118	29.9.2006.
	Rosaceae	*Fragaria vesca* L.	Umag*	33T UL8432	1.6.2005.
	Solanaceae	*Brunfelsia americana* L.	Zagreb Botanički vrt*	33T WL7572	5.5.2006.
		Lycopersicon esculentum Mill.	Bijele Zemlje*	33T UL9924	26.10.2006.
	Vitaceae	*Partenocissus* sp.	Zagreb Zrinjevac*	33T WL7469	24.5.2006.
TOTAL	**12 plant families**	**19 host plants**	**15 localities**	–	–

* Greenhouses, households and other indoors

Fig. 2. Adult female of *Planococcus ficus* (Signoret, 1875) (photo: T. Masten Milek)

Tab. 2. Host plants, localities and date of finding of *Planococcus ficus* (Signoret, 1875) determined during a four-year faunistic investigation in Croatia (2005-2008)

SPECIES	PLANT FAMILY	HOST PLANT	LOCALITY	UTM	DATE
Planococcus ficus (Signoret, 1875)	Moraceae	*Ficus carica* L.	Solin	33T XJ2022	29.9.2006.
	Vitaceae	*Vitis vinifera* L.	Repušnica	33T XL3540	1.6.2006.
		Vitis vinifera L.	Novigrad Salvela	33T UL8719	21.9.2006.
		Vitis vinifera L.	Lovorno	34T BN8313	24.7.2006.
		Vitis vinifera L.	Škudelin	33T UL9632	6.10.2006.
		Vitis vinifera L.	Saplunara Mljet	33T YH2430	28.9.2006.
		Vitis vinifera L.	Krčulj	33T WJ7861	29.9.2006.
		Vitis vinifera L.	Samobor	33T WL5572	15.6.2007.
		Vitis vinifera L.	Buje	33T UL9529	25.6.2007.
		Vitis vinifera L.	Ilok	34T CR7308	22.5.2008.
TOTAL	**2 plant families**	**2 host plants**	**10 localities**	–	–

Planococcus vovae (Nasonov, 1908)

P. vovae is distributed widely within the Palaearctic region. It is known as the pest of many host plants belonging to the family Cupressaceae. Sometimes it can even attack plants belonging to the genera *Anthurium*, *Laurus* and *Taxus* (BEN-DOV, 2008).

The adult female is oval and brownish (see Fig. 3.). The body of the adult female is always visible at the end of the ovisac (see Fig. 4.),which is a unique characteristic within the genus *Planococcus* (KOSZTARAB & KOZÀR, 1988). Mounted specimens are 1.3–3.4 mm long and 0.7–2.3 mm wide. The margin of the body has a complete series of 18 pairs of cerarii, each with 2 slender conical setae, noticeably more slender and flagellate towards the anterior end of the body (Cox, 1989) (Fig. 5.).

In Croatia *P. vovae* was detected for the first time in August 2006 on *Juniperus oxycedrus* L. in Senj (MASTEN MILEK, 2007). Large colonies on branches were intensively attended by the ant *Crematogaster scutellaris* (Olivier, 1792) (see Fig 3.), in line with Hungarian data (KOSZTARAB & KOZÀR, 1978). During our investigation, this species was found in 7 localities and on 3 different host plants (all belonging to the family Cupressaceae) (see Tab. 3.).

Notes on morphological and ecological characters of *Planococcus citri*, *P. ficus* and *P. vovae*

P. vovae can be easily separated from *P. citri* and *P. ficus* on the basis of its host plant: *P. vovae* lives mainly on Cupressaceae whereas *P. citri* and *P. ficus* are poly-

Fig. 3. Adult female of *Planococcus vovae* (Nasonov, 1908) attended by the ant *Crematogaster scutellaris* (Olivier, 1792) (photo: T. Masten Milek)

Fig. 4. Adult females of *Planococcus vovae* (Nasonov, 1908) with ovisacs and 1st instar larvae (photo: T. Masten Milek)

phagous species not usually associated with coniferous plants. *P. citri* is well known as a very common pest in greenhouses while *P. ficus* is known as a grapevine pest. Macroscopic characters (i.e. shape and colour of adult female, waxy filaments) are not very useful to differentiate these three species, because they look very similar

Tab. 3. Host plants, localities and date of finding of *Planococcus vovae* (Nasonov 1908) determined during a four-year faunistic investigation in Croatia (2005-2008)

SPECIES	PLANT FAMILY	HOST PLANT	LOCALITY	UTM	DATE
Planococcus vovae (Nasonov, 1908)	Cupressaceae	*Juniperus oxycedrus* L.	Senj	33T VK9282	13.8.2006.
		Juniperus oxycedrus L.	Primošten	33T WJ7526	1.10.2006.
		Juniperus sabina L.	Zagreb Vinogradska	33T WL7474	31.3.2007.
		Cupressus sempervirens L.	Samobor Cvjetno naselje	33T WL5572	23.5.2007.
		Cupressus sempervirens L.	Kaštel	33T UL9632	1.10.2007.
		Cupressus sempervirens L.	Zagreb Jarun	33T WL7471	31.5.2008.
		Cupressus sempervirens L.	Pula Agrofarmacija	33T VK0969	18.6.2008.
TOTAL	**1 plant family**	**3 host plants**	**7 localities**	**–**	**–**

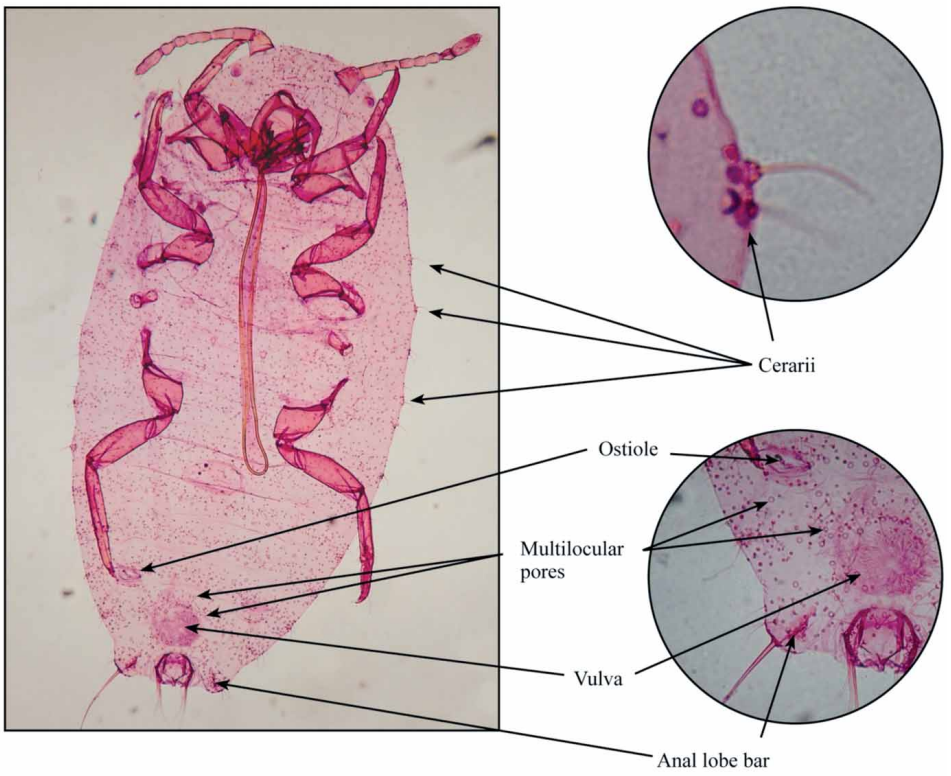

Fig. 5. Microscopic permanent slide of adult female of *Planococcus vovae* (Nasonov, 1908) with some details for identification (photo: T. Masten Milek)

(Fig. 1., 2. and 3.). It should be pointed out that only identification on the basis of microscopic morphological characters, according to the relevant keys can give reliable results for species identity.

Slide mounted females of *P. citri, P. ficus* and *P. vovae* are very similar as well. Some microscopic characters important for a reliable identification of *P. citri, P. ficus* and *P. vovae* are given in Tab. 4.

CONCLUSIONS

In Croatia the genus *Planococcus* currently consists of three species: *P. citri, P. ficus* and *P. vovae*. All three species are widespread in the country. *P. citri* is a very common pest in greenhouses and on indoor plants, *P. ficus* is a grapevine pest and *P. vovae* is a pest most to be found on Cupressaceae. *P. vovae* is a new scale insect species for the fauna of Croatia.

Tab. 4. Some important distinctive microscopic characters of *P. citri, P. ficus* and *P. vovae*

Validation characters	***P. citri***	***P. ficus***	***P. vovae***
cerarii	18 pairs, each with 2 conical setae, except for preopercular cerarii which may have 1 to 3 setae each	18 pairs, each with 2 conical setae, more slender towards anterior end of the body	18 pairs, each with 2 slender conical setae, noticeably more slender and flagellate towards anterior end of the body
anal lobe cerarii	situated on a small, slightly sclerotized area	situated on a small, slightly sclerotized area	situated on a small, slightly sclerotized area
circulus	quadrate	quadrate	quadrate
ostioles	inner edges moderately sclerotized	inner edges moderately sclerotized	well defined, but with lip edges weakly sclerotized
setae on median areas of venter	long, fine and flagellate	long, fine and flagellate	long, fine and flagellate
setae on dorsum	flagellate	flagellate	stout almost lanceolate
ventral oral-collar tubular ducts between antennae	> 5	< 5	–
translucent pores	on hind coxae and tibia	on hind femur in addition to hind coxae and tibia	on hind coxae and a few pores sometimes visible on each hind tibia

Because *P. ficus* is known as pest of grapevines (confirmed for Croatia by our investigation) and because there were many misidentifications of this species as *P. citri* in the past, we have some doubts regarding faunistic data in the literature with respect to *P. citri* on *V. vinifera*. We suggest that this was probably a case of misidentification of *P. ficus*.

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SAŽETAK

Vrste roda *Planococcus* Ferris, 1950 (Hemiptera: Coccoidea: Pseudococcidae) s naglaskom na *Planococcus vovae* (Nasonov, 1908) kao novoregistriranoj vrsti u Hrvatskoj

T. Masten Milek, M. Šimala & S. Krčmar

Prema BEN-DOVU (2008), rod *Planococcus* Ferris, 1950 (porodica Pseudococcidae) u Palearktičkoj regiji broji 11 vrsta. Na području Europe registrirano je sljedećih 5 vrsta: *Planococcus citri* (Risso, 1813), *Planococcus ficus* (Signoret, 1875), *Planococcus halli* Ezzat & McConnell, 1956, *Planococcus taigae* Danzig, 1986 i *Planococcus vovae* (Nasonov, 1908). *P. citri*, *P. ficus* i *P. vovae* su autohtone europske vrste koje su široke rasprostranjene u Europi. *P. halli* je introducirana vrsta koja je zabilježena samo u Italiji, dok je *P. taigae* eurazijska vrsta koja je ograničena samo na područje Rusije.

Četverogodišnjia faunistička istraživanja (2005.-2008.) roda *Planococcus* u Republici Hrvatskoj provedena su na području 21 županije. U istraživanjima su korišteni sljedeći materijali i metode rada: skupljanje uzoraka biljnog materijala na temelju vizualnih pregleda, obrada uzoraka pod binokularom, pohranjivanje i čuvanje uzoraka, priprema mikroskopskih preparata, determinacija i označavanje lokaliteta faunističkih nalaza prema UTM sustavu.

Istraživanjem su utvrđene vrste *P. citri*, *P. ficus* i *P. vovae*. *P. citri* registrirana je samo u zaštićenim prostorima (staklenici, plastenici, domaćinstva i sl.) na 15 lokaliteta, na 19 različitih biljaka domaćina. *P. ficus* utvrđena je na 10 lokaliteta, na 2 različita domaćina i to u najvećem broju slučajeva na *Vitis vinifera P. vovae* je pronađena na 7 lokaliteta na 3 različita domaćina iz porodice Cupressaceae. Ovo je novoregistrirana vrsta štitaste uši za Hrvatsku.

Kako su mnogobrojni nalazi *P. citri* na *V. vinifera* u prošlosti bili kriva identifikacija *P. ficus* (Cox, 1989) te su prema našim četverogodišnjim istraživanjima, sve pronađene jedinke roda *Planococcus* na *V. vinifera* u različitim dijelovima Hrvatske bile isključivo *P. ficus*, opravdano možemo sumnjati u točnost faunističkih podataka hrvatske literature o *P. citri* na *V. vinifera*. Bilo je potrebno istaknuti ovu činjenicu, budući da još i danas mnogobrojni autori koji nisu kokcidolozi pišu o *P. citri* kao vrlo značajnom štetniku *V. vinifera* u Hrvatskoj.

Iz četverogodišnjih istraživanja možemo zaključiti da u Hrvatskoj vrsta *P. citri* predstavlja vrlo značajnog, izuzetno polifagnog štetnika biljaka u zaštićenim prostorima, *P. ficus* može biti vrlo opasan štetnik *vinove loze*, a *P. vovae* je štetnik domaćina iz porodice Cupressaceae. Sve tri vrste široko su rasprostranjene u Hrvatskoj.